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Meintschel et al.

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(54) **INTERNAL COMBUSTION ENGINE HAVING A VARIABLE COMPRESSION RATIO**

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(30) **Foreign Application Priority Data**

Oct. 1, 2005 (DE) 10 2005 047

(51) **Int. Cl.**
F02B 75/04 (2006.01)

(52) **U.S. Cl.** .... **123/48 B**; 123/48 C; 123/78 BA; 123/78 C

(58) **Field of Classification Search** .... 123/48 R–48 D, 123/78 R–78 F

See application file for complete search history.

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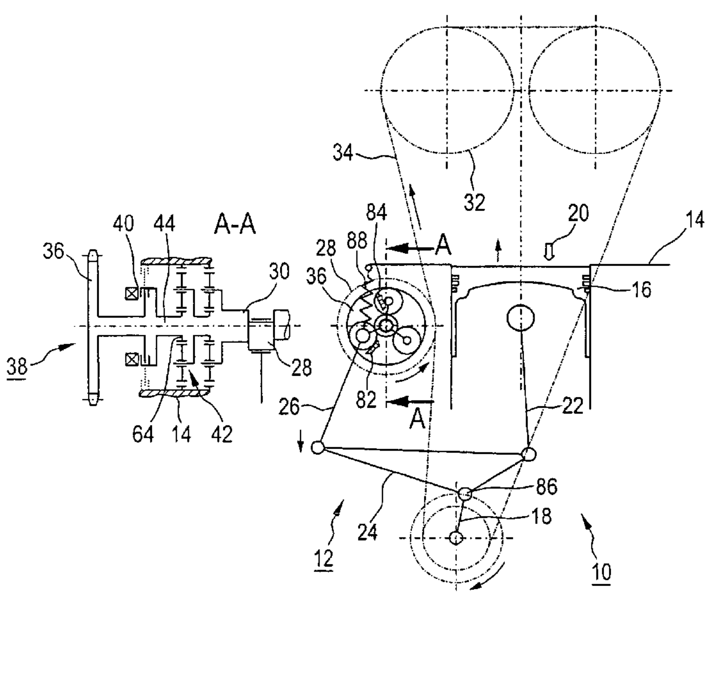
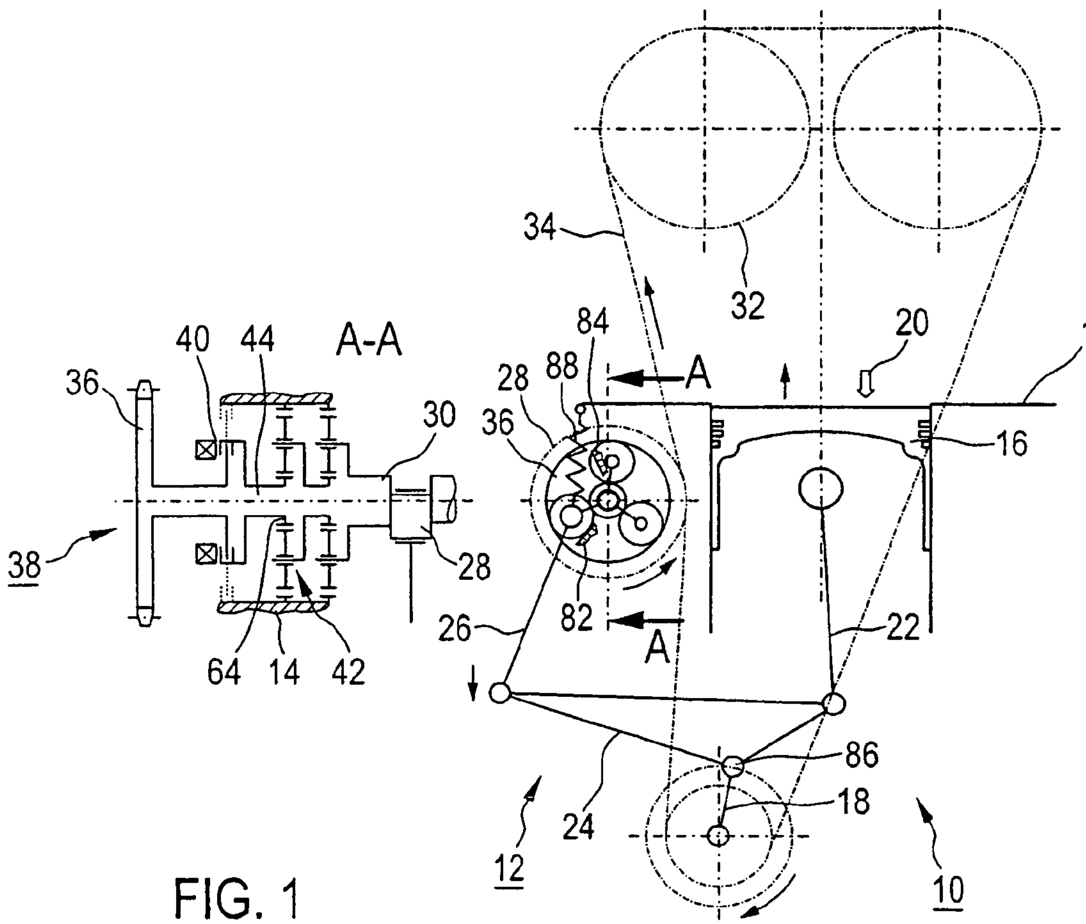
(57) **ABSTRACT**

In an internal combustion engine including cylinders arranged in a housing, a crankshaft, pistons disposed in the cylinders so as to be movable by the crankshaft, and a device for varying a compression ratio of the internal combustion engine wherein the device, for varying the compression ratio, includes an adjusting structure which varies the effective length of a connecting rod of the piston, the lift of the crankshaft or the position of the cylinder with respect to the center of the crankshaft, an operating structure is provided by rotation of which the position of the adjusting structure can be controlled, and a drive device for controlling the operating structures contains a coupling mechanism with an integrated brake function, whereby h the adjusting structure can either be placed in operative connection with the crankshaft or can be blocked.

6 Claims, 11 Drawing Sheets





A-A
40
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FIG. 1

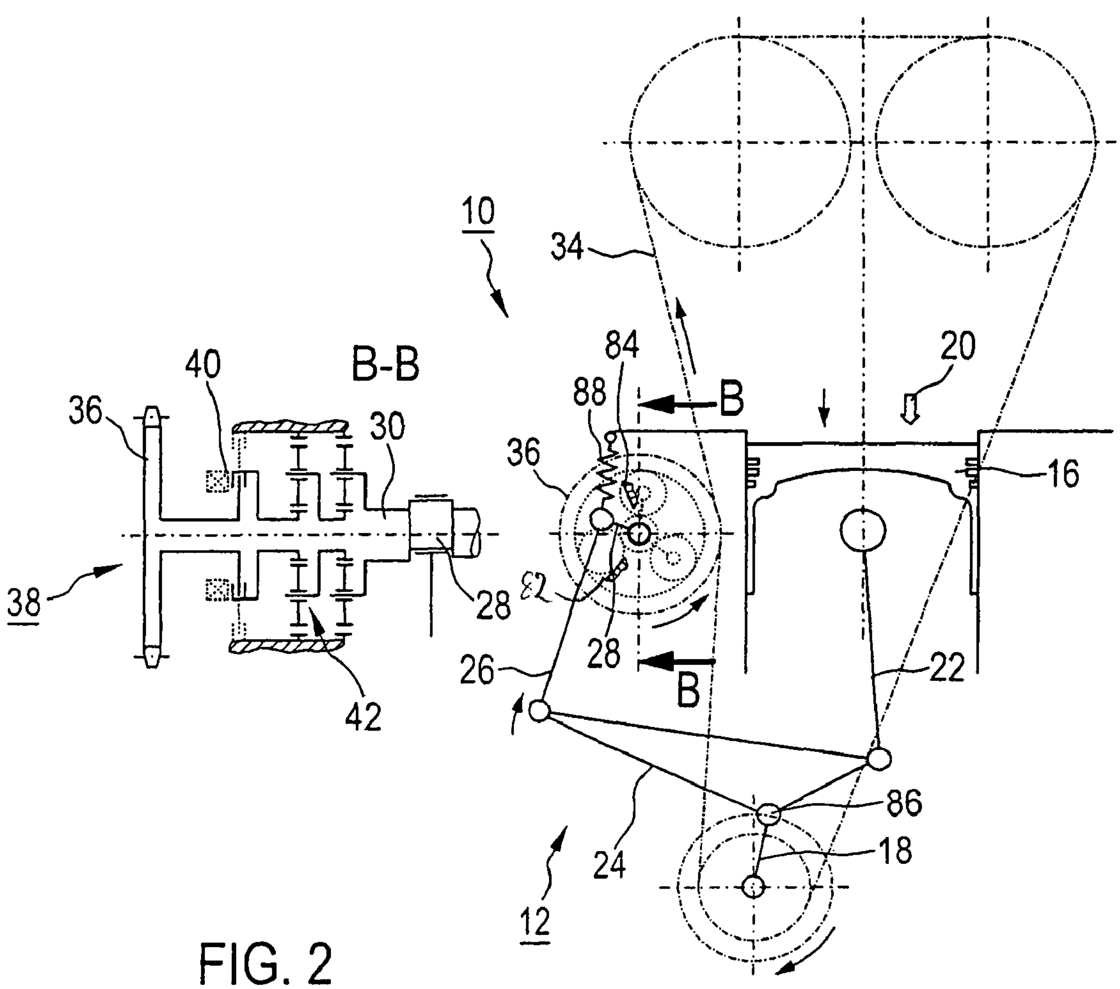


FIG. 2

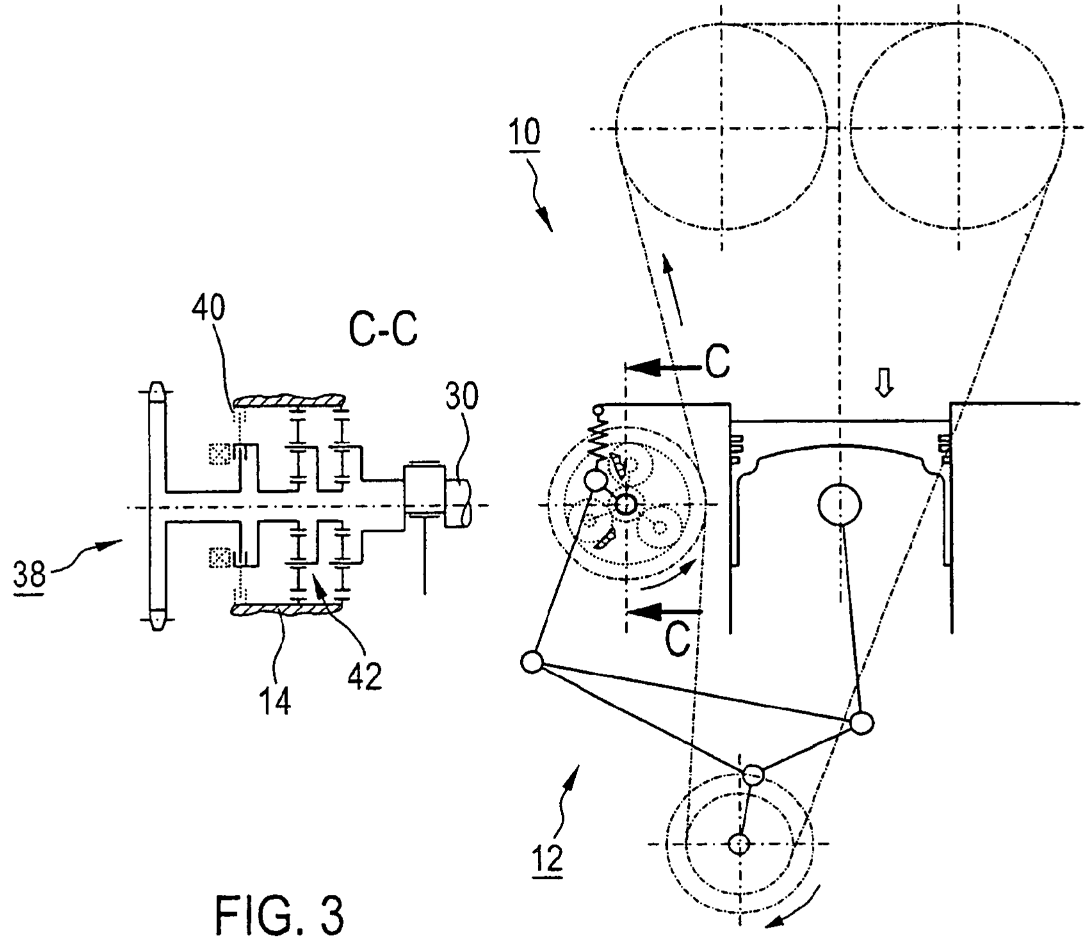


FIG. 3

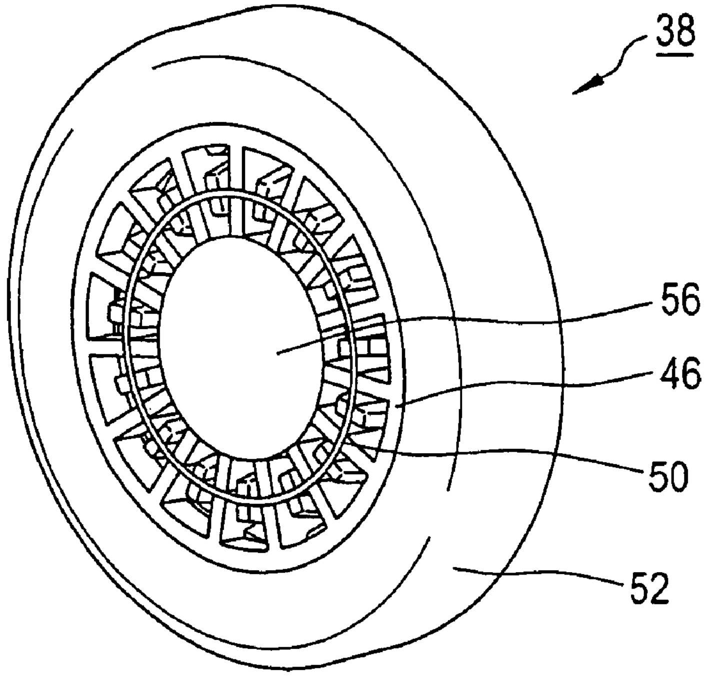


FIG. 4A

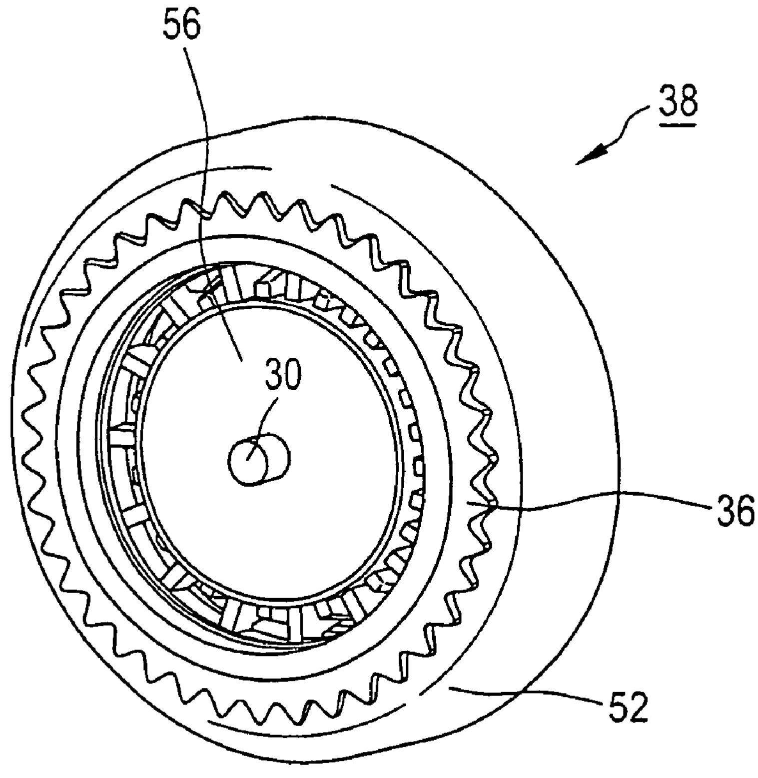


FIG. 4B

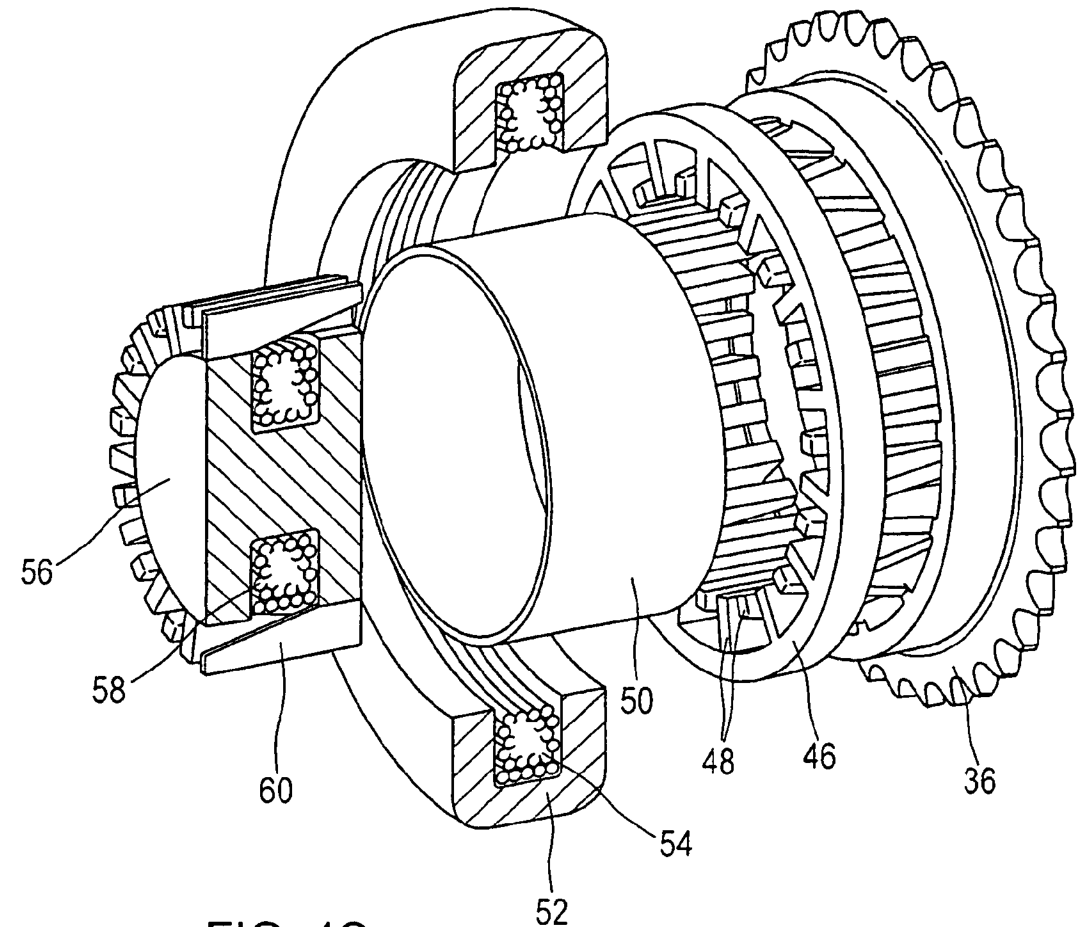


FIG. 4C

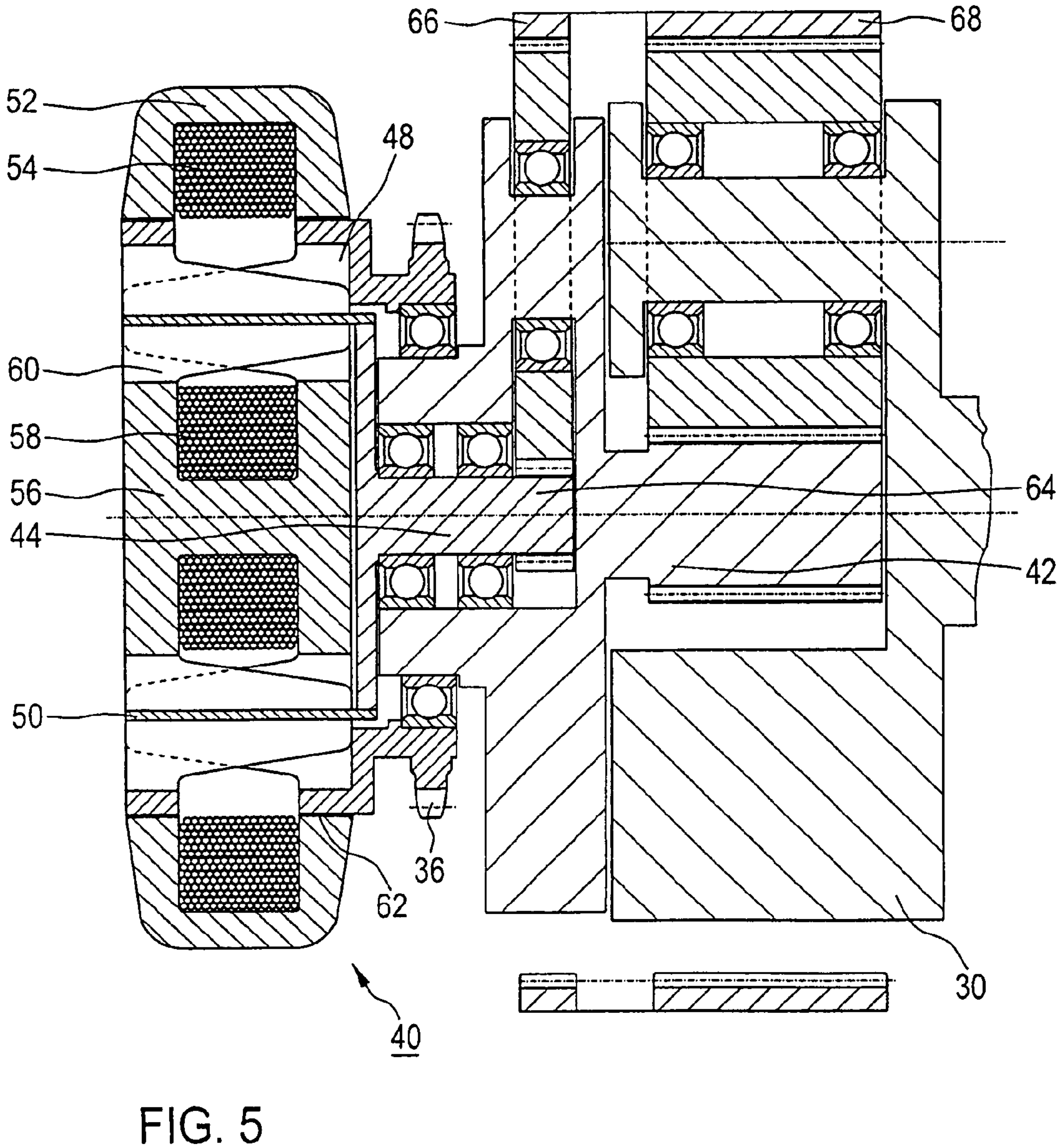


FIG. 5

FIG. 6A

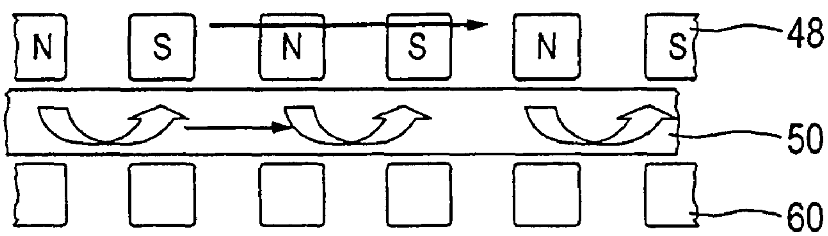
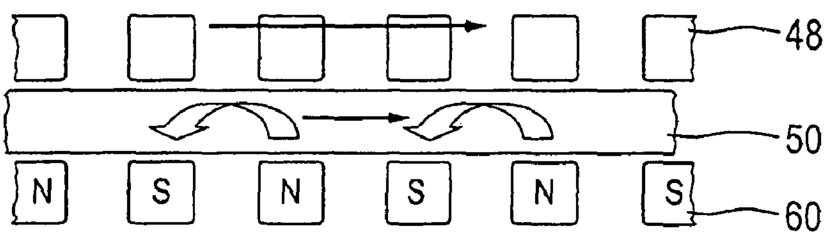


FIG. 6B



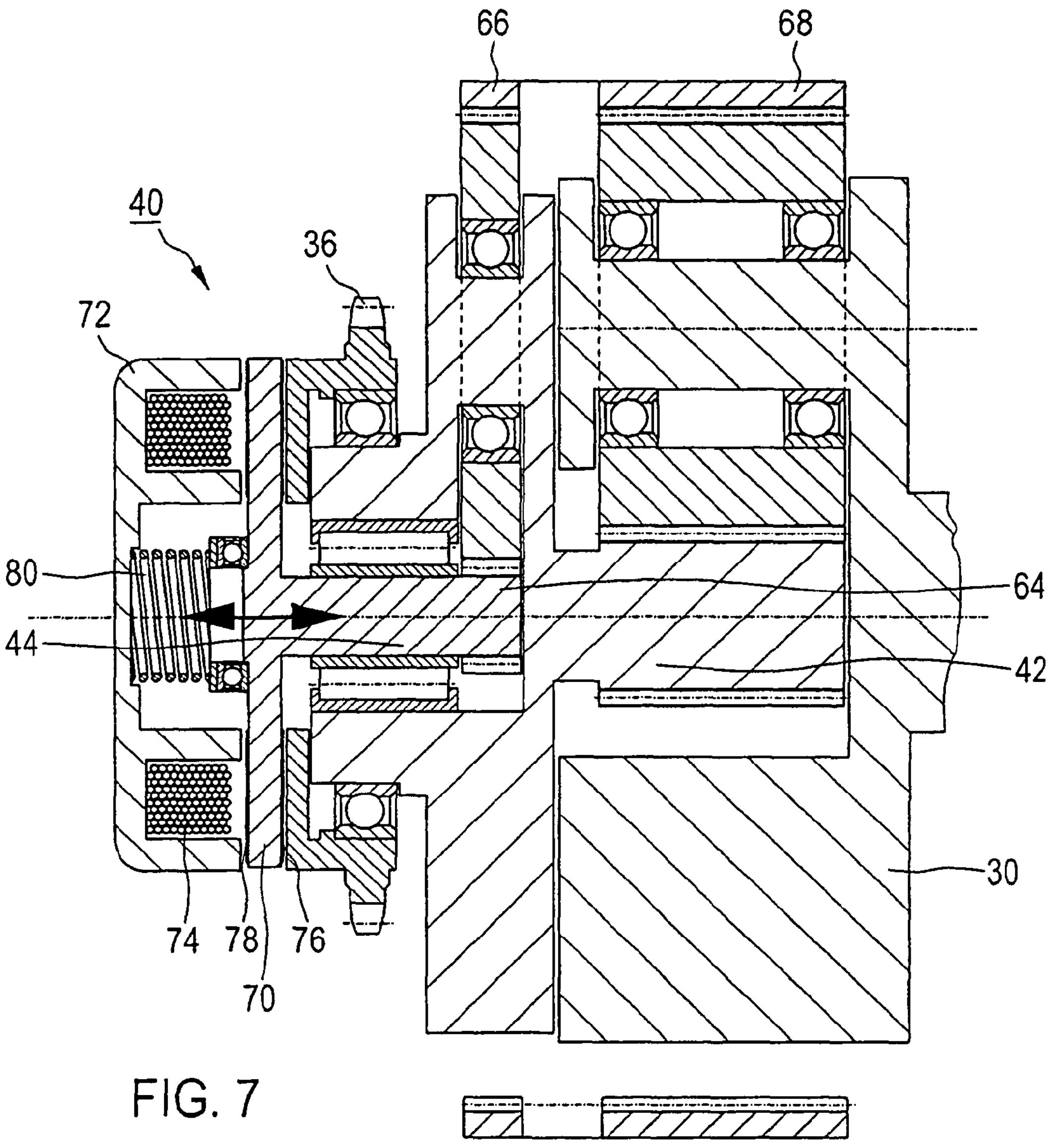


FIG. 7

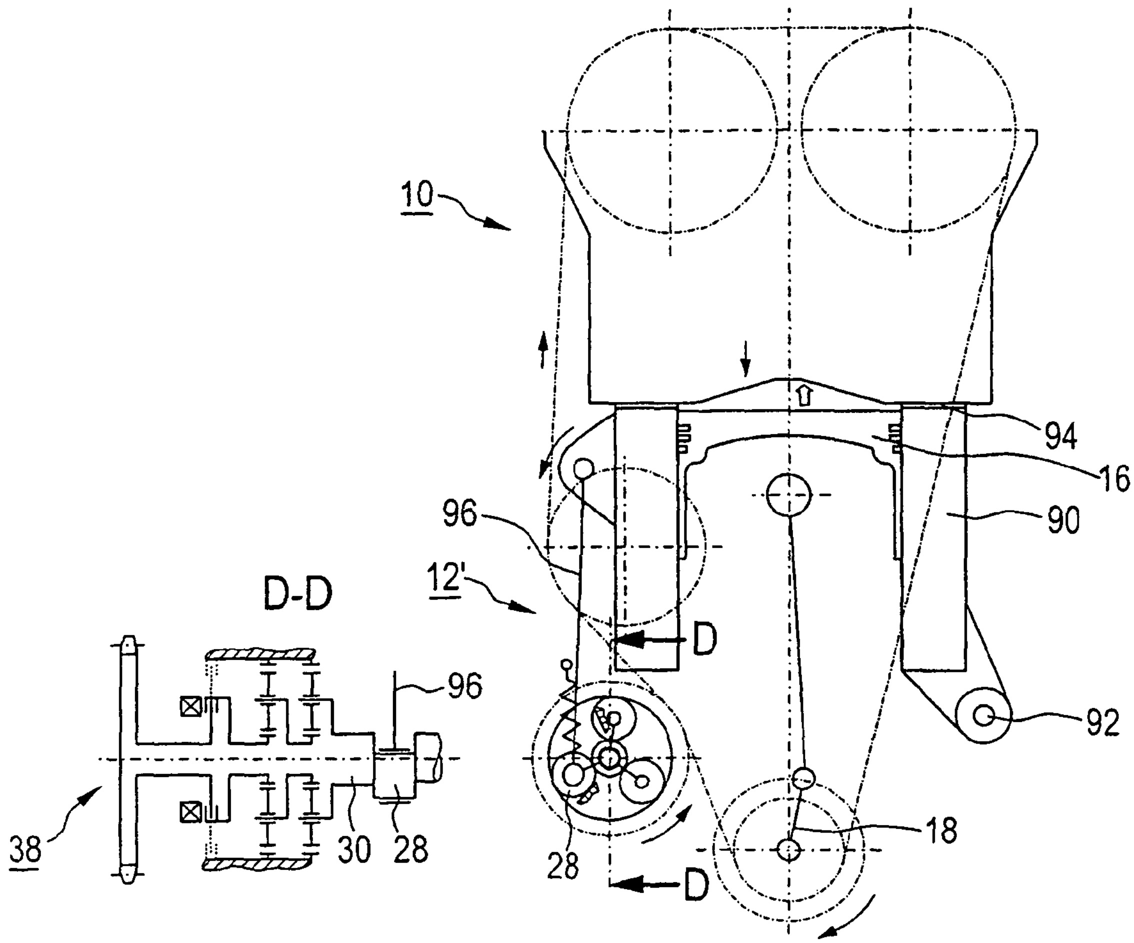


FIG. 8

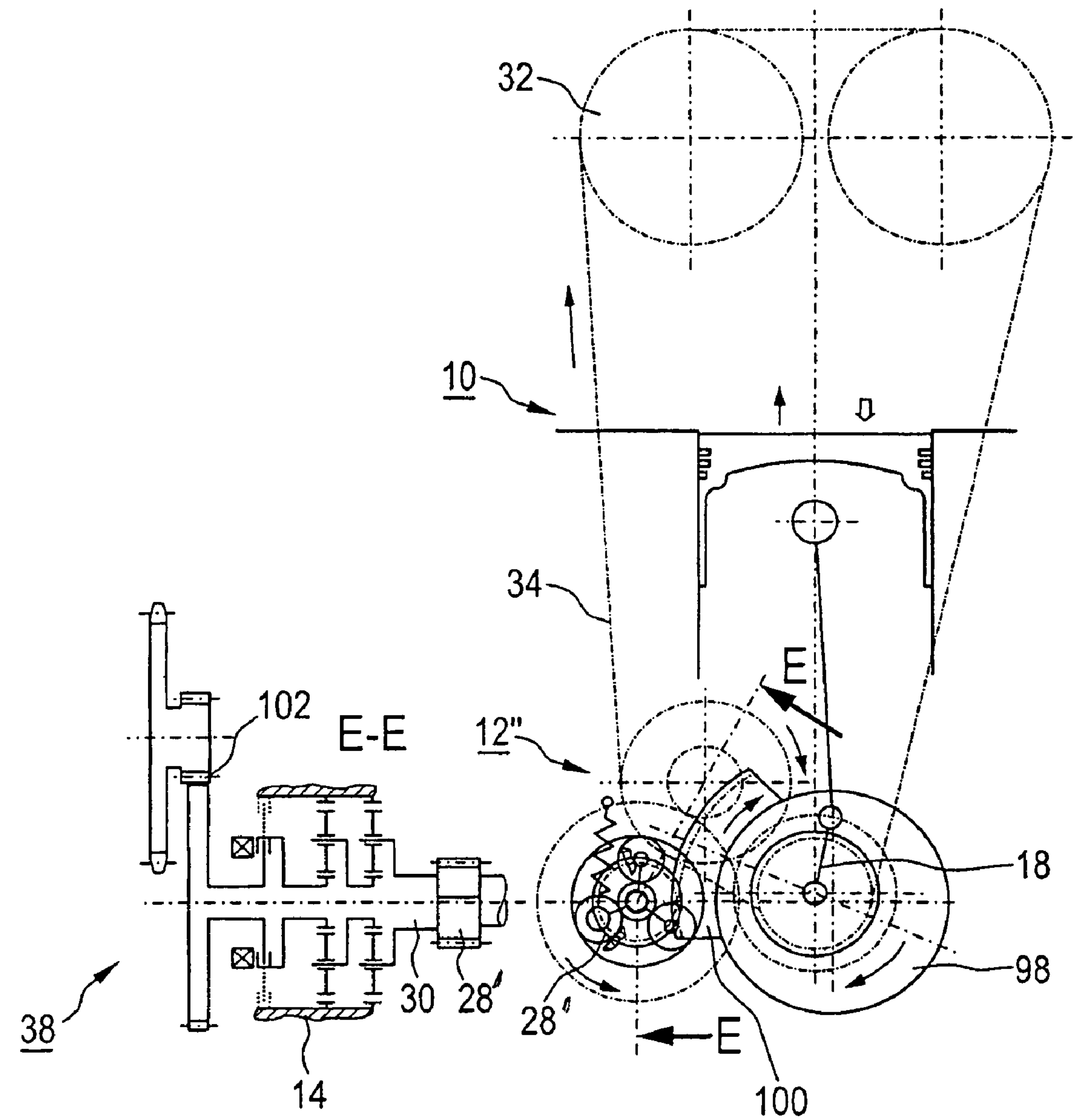


FIG. 9

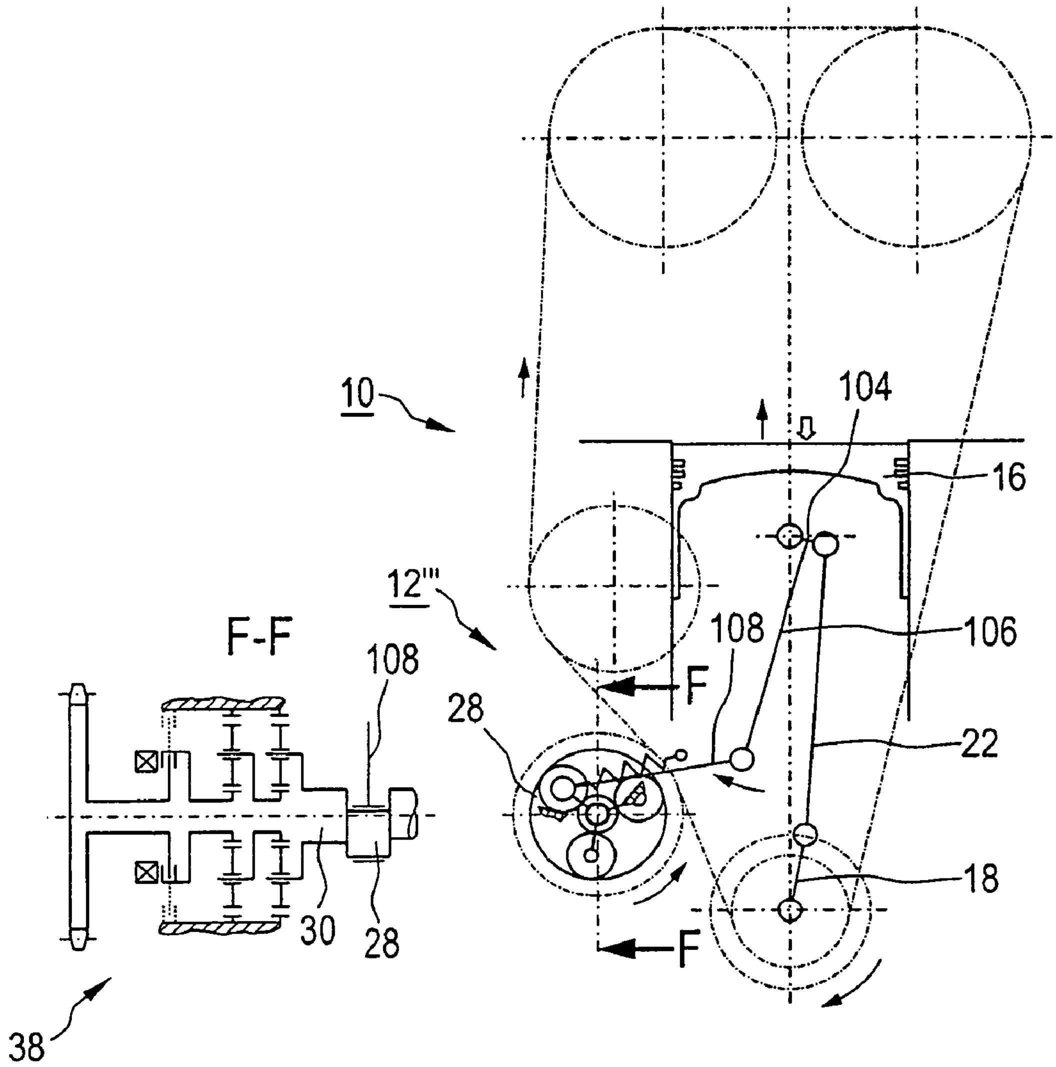


FIG. 10

INTERNAL COMBUSTION ENGINE HAVING A VARIABLE COMPRESSION RATIO

This is a Continuation-in-Part Application of pending International patent application PCT/EP2006/009121 filed Sep. 20, 2006 and claiming the priority of German patent application 10 2005 047 203.6 filed Oct. 1, 2005.

BACKGROUND OF THE INVENTION

The invention relates to an internal combustion engine having a variable compression ratio obtained by varying the length of the connecting rods of the piston, the position of the crankshaft or the position of the cylinder head relative to the cylinder.

EP 1 307 642 B1 discloses a reciprocating-piston internal combustion engine having a device for varying the compression ratio. The device has, in particular for one cylinder of the internal combustion engine, a main connecting rod which is connected to a piston, a transverse lever which is connected by means of pivot joints to the main connecting rod and to the crankshaft, an auxiliary connecting rod which is connected by means of pivot joints to a transverse lever and to an eccentric which is assigned to the at least one cylinder, and a drive device for an adjusting shaft on which the eccentric is arranged.

By means of rotation of the adjusting shaft and therefore by means of rotation of the eccentric, the position and the setting of the auxiliary piston rod and of the trans-verse lever are adjustable. The position of the piston of the internal combustion engine is therefore moved, and the compression ratio is therefore varied. The adjusting shaft with the eccentric performs a rotational movement which is synchronous with the crankshaft, or it is rotated by means of an adjusting mechanism (not shown specifically). This known device is suitable for adjusting the compression ratio while simultaneously improving the engine operating smoothness.

DE 30 04 402 A1 shows a device for adjusting the compression ratio of reciprocating-piston internal combustion engines, in which the center of the crankshaft can be adjusted relative to the position of the cylinders via an eccentric bearing arrangement, as a result of which the compression ratio is changed.

EP 0 640 176 B1 likewise discloses a device for adjusting the compression ratio of reciprocating-piston internal combustion engines, in which the cylinders are tilted relative to the housing of the internal combustion engine via an eccentric, which is mounted on an adjusting shaft, and levers. In this way, the position of the upper edge of the cylinders changes relative to the center of the crankshaft, and, as a result, a variation of the compression ratio takes place during the adjusting process.

DE 102 21 334 A1 likewise describes a device for adjusting the compression ratio of reciprocating-piston internal combustion engines, in which, similarly to EP 0 640 176 B1, the upper edge of the cylinders is moved relative to the center of the crankshaft. In this case, the upper part of the cylinder housing is moved in a translatory fashion by means of two eccentrics which are mounted on adjusting shafts, and the compression ratio is thereby varied.

DE 100 26 634 A1 likewise discloses a device for adjusting the compression ratio of reciprocating-piston internal combustion engines, in which an eccentric is arranged between the piston rod and the piston of the internal combustion engine. Said eccentric can be adjusted externally by an adjusting shaft via levers, as a result of which the compression ratio is likewise changed.

A feature of all of the above-mentioned reciprocating-piston internal combustion engines is the variation of the compression ratio by means of rotation of at least one adjusting shaft.

It is an object of the present invention to provide a mechanism for facilitating rotation of an adjusting shaft for changing the transmission ratio of an engine by a simple and compact means and with little energy input.

SUMMARY OF THE INVENTION

In an internal combustion engine including cylinders arranged in a housing, a crankshaft, pistons disposed in the cylinders so as to be movable by the crankshaft, and a device for varying a compression ratio of the internal combustion engine wherein the device for varying the compression ratio includes an adjusting structure which varies the effective length of a connecting rod of the piston, the lift of the crankshaft or the position of the cylinder with respect to the center of the crankshaft, an operating structure is provided by rotation of which the position of the adjusting structure can be controlled, and a drive device for controlling the operating structures contains a coupling mechanism with an integrated brake function, by means of which the adjusting structure can either be placed in operative connection with the crankshaft or can be blocked.

In a particular embodiment, an eccentric which is assigned to a particular cylinder is mounted in the housing and, by rotation, changes the position and/or direction of an adjusting link or lever. A drive device, which is driven by the crankshaft, is provided for driving a adjusting shaft on which the eccentric is arranged. The internal combustion engine according to the invention is distinguished in that the drive device of the device for varying the compression ratio contains a coupling mechanism with an integrated brake function, by means of which the adjusting shaft can be selectively connected to the crankshaft or it can be locked.

The drive device of the device for varying the compression ratio permits an adjustment to a high compression ratio, an adjustment to a low compression ratio and maintaining a given setting.

In order to rotate the adjusting shaft and therefore the eccentric for adjustment to a high compression ratio, energy is supplied to the drive device by the crankshaft and is then transmitted to the adjusting shaft via the coupling mechanism. If the present compression ratio is to be maintained, then a rotation of the adjusting shaft is blocked by the brake function integrated in the coupling mechanism. If the drive device neither places the adjusting shaft in operative connection with the crankshaft nor blocks it, the adjusting shaft can automatically rotate in the direction of low compression. In order to rotate the adjusting shaft and therefore the eccentric for adjustment to a low compression ratio, energy is supplied to the components by the gas pressure in the combustion space, with free rotation of the adjusting shaft being made possible by the base of the coupling mechanism.

The drive device can be actuated in every operating position of the internal combustion engine. The coupling mechanism with the integrated brake function makes a very compact construction of the drive device with few components possible.

Depending on the embodiment of the device for varying the compression ratio, the compression ratio is brought about by varying the length of the piston rod, varying the piston stroke and/or displacing the upper edge of the cylinder relative to the crankshaft.

In an advantageous refinement of the invention, the coupling mechanism has a rotor made of a hysteresis material which is operatively connected to the adjusting shaft. A first pole structure is connected in a rotationally fixed manner to a drive wheel driven by the crankshaft; and a second pole structure is connected fixedly to the housing, with it being possible to optionally activate the first and the second pole structures. In this case, the first pole structure can be assigned a first housing-mounted winding, and the second pole structure can be assigned a second housing-mounted winding, which windings can optionally be energized in order to activate the coupling function or the brake function of the coupling mechanism.

In an alternative embodiment of the invention, the coupling mechanism has an armature made of a magnetizable material, which is operatively connected to the adjusting shaft. A spring element biases the armature into a rotational connection with a drive wheel driven by the crankshaft; and an optionally activatable winding is fixedly connected to the housing for pulling the armature counter to the force of the spring element into connection with the housing. The brake function of the coupling mechanism is activated by energization of the winding.

In a further refinement of the invention, the drive device furthermore has a gearing, for example a two-stage planetary gear set, and therefore the rotational movement of the crankshaft can be transmitted to the adjusting shaft in a significantly slowed manner. This increases the adjusting accuracy of the eccentric and, in addition, reduces the power loss of the coupling mechanism. The position of the adjusting shaft can additionally be detected in this case by means of a sensor.

In a further refinement of the invention, the drive device can advantageously be operatively connected to a wraparound drive or rolling contact gearing for driving camshafts.

Further features and advantages of the invention will become more readily apparent from the following description with reference to the attached drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a schematic illustration of a first embodiment of a device for varying the compression ratio in a setting for high compression;

FIG. **2** shows a schematic illustration of the first embodiment of the device for varying the compression ratio in a setting for low compression;

FIG. **3** shows a schematic illustration of the first embodiment of the device for varying the compression ratio in a setting with the adjusting shaft blocked;

FIGS. **4**A, **4**B, and **4**C show perspective views of a drive device for an adjusting shaft according to a first exemplary embodiment of the invention;

FIG. **5** shows a sectional view of the drive device for an adjusting shaft of FIG. **4**;

FIGS. **6**A and **6**B show schematic illustrations for explaining the functioning of the drive device for an adjusting shaft according to FIG. **4**;

FIG. **7** shows a sectional view of a drive device for an adjusting shaft according to a second exemplary embodiment of the invention;

FIG. **8** shows a schematic illustration of a second embodiment of a device for varying the compression ratio;

FIG. **9** shows a schematic illustration of a third embodiment of a device for varying the compression ratio; and

FIG. **10** shows a schematic illustration of a fourth embodiment of a device for varying the compression ratio.

DESCRIPTION OF THE VARIOUS EMBODIMENTS

FIG. **1** illustrates, schematically in a cross section and a partial longitudinal section, an internal combustion engine **10** having a device **12** for varying the compression ratio, in an operating state of the adjustment set to a high compression ratio. The internal combustion engine **10** has a housing **14** in which the piston **16** and the crankshaft **18** move. The piston **16** is moved downward by the gas force **20** and transmits said movement via the main connecting rod **22** and the transverse lever **24** to the crankshaft **18**. The trans-verse lever **24** is supported by means of the auxiliary connecting rod **26**, which serves as an adjusting link supported by an eccentric **28** which, for its part, is arranged on the adjusting shaft **30**.

The internal combustion engine **10** furthermore has two camshafts **32** which are driven via a wraparound drive **34**, for example a chain drive, by the crankshaft **18**. The wraparound drive **34**, for its part, drives a sprocket **36** which serves as the drive wheel and is connected to the adjusting shaft **30** via a drive device **38**. The drive device **38** contains, in particular, a coupling mechanism **40** with an integrated brake function, and a gearing **42**. The input-side shaft piece **44** of the gearing **42** can be connected via the coupling mechanism **38** both to the sprocket **36** (coupling function) and to the housing **14** (brake function).

The construction and the functioning of a drive device **38** for the adjusting shaft **30** according to a first exemplary embodiment is now explained in more detail with reference to FIGS. **4** to **6**.

The sprocket **36** which is driven by the wraparound drive **34** is formed integrally with a rotor **46** having a first pole structure **48** which rotates together with the sprocket **36**. An annular coupling rotor **50**, which is made of a hysteresis material, serves as a magnetic coupling and brake element and is also connected in a rotationally fixed manner to the input shaft **44** of the gearing **42**, is arranged radially within said rotor **46**. The hysteresis material is preferably half-hard magnetically and has a pronounced loop in the B-H diagram. The rotor **46** with the first pole structure **48** is furthermore surrounded radially by a first housing-mounted stator **52** with a winding **54**. A second housing-mounted stator **56** with a winding **58** and a second pole structure **60** is arranged radially within the rotor **46** and within the coupling rotor **50**.

As illustrated in FIGS. **6**A and **6**B, the coupling rotor **50** made of the hysteresis material has the flow passing tangentially through it when the winding **54** of the first stator **52** is energized, because of the first (coupling-side) pole structure **48** on its outer side (at the top in FIG. **6**A) or has the flow passing tangentially through it when the winding (**58**) of the second stator **56** is energized, because of the second (brake-side) pole structure **60** on its inner side (at the bottom in FIG. **6**B). In this case, the magnetic flux from the winding **54** is coupled into the rotating pole structure **48** via an air gap **62**. The constant magnetic reversal of the hysteresis material during movement of the coupling rotor **50** gives rise to an application of force which either accelerates the coupling rotor **50** (FIG. **6**A) or brakes it (FIG. **6**B).

The drive device **38** constructed in such a manner operates contactlessly and in a manner free from wear and, in addition, can easily be controlled. Owing to the integration of the brake function into the coupling mechanism **40**, a very compact construction is made possible with few components. The coupling moment and the brake torque are virtually independent of the rotational speed. In addition to the coupling rotor **50**, which is made from a hysteresis material, having an annular or band-shaped construction, which is illustrated in FIGS. **4** and **5**, a disc-shaped construction of the coupling rotor **50** is also conceivable.

The gearing **42** can be embodied, for example, as a two-stage planetary gear set, as illustrated in FIGS. **1** and **5**. The input-side sun gear **64** is connected to the input-side shaft piece **44**, which is driven by the sprocket **36**, and the output-side web is connected to the adjusting shaft **30**. The internal gears **66**, **68** of the two stages of the two-stage planetary gear set **42** are in each case supported on the housing **14**.

A description of the construction and of the functioning of a drive device **38** for the adjusting shaft **30** according to a second preferred exemplary embodiment now follows with reference to FIG. **7**.

In comparison to the drive device **38** described above with reference to FIGS. **4** to **6**, in this exemplary embodiment of the drive device **38** for the adjusting shaft **30**, instead of two activatable pole structures **48**, **60** and a coupling rotor **50** made of a hysteresis material, the following design is provided.

An armature **70** made of a magnetizable material is connected integrally here to the input-side shaft piece **44** of the gearing **42**. Said magnetizable armature **70** is placed axially between the sprocket **36**, which is driven by the crankshaft **18**, and a housing-mounted stator **72** with an integrated winding **74**. In addition, the armature **70** is provided with a respective friction lining **76**, **78** on each of its two axial sides and is biased in the direction of the sprocket **36** by means of a spring element **80** supported on the housing-mounted stator **72**.

Without the winding **74** of the stator **72** being energized, the armature **70** is pressed with its friction lining **76** against the sprocket **36** by means of the spring element **80**, such that the armature **70** and therefore also the input-side shaft piece **44** of the gearing **42** rotate together with the sprocket **36**. In other words, the adjusting shaft **30** is placed in operative connection with the crankshaft **18** by means of the switched-on coupling mechanism **40**. When the winding **74** of the stator **72** is energized, the magnetizable armature **70** is pulled in the direction of the housing-mounted stator **72** counter to the force of the spring element **80** and therefore the gearing input **44** is braked. The compensation for the resulting axial movement of the gearing input **44** (for example <1.0 mm) is absorbed by the displaceable sun gear **64** of the planetary gear set **42**.

The remaining components of the drive device **38** are identical to those of the first exemplary embodiment above, and therefore repeated explanation of the same is omitted.

Again with reference to FIG. **1**, the two-stage planetary gear set **42** of the drive device **38** converts the rotational speed of the sprocket **36** into a low rotational speed of the adjusting shaft **30**. In addition, two housing-mounted stops **82**, **84** are provided for the adjusting shaft **30**, which stops delimit a possible rotational angle of the adjusting shaft to, for example, approximately 100° to approximately 150°. In addition, a sensor (not illustrated) can be provided for detecting the rotational position of the adjusting shaft **30**.

An adjusting process of the compression ratio from a low compression to a high compression takes place in the following way.

As indicated in FIG. **1**, the crankshaft **18** rotates clockwise and, in the process, drives the wraparound drive **34**. As a result, the sprocket **36** is rotated counter to the direction of rotation of the crankshaft **18**. If the operating range of the internal combustion engine **10** is to be adjusted in the direction of high compression, a control unit (not shown) causes the coupling mechanism **40** of the drive device **38** to be switched on, that is to say, for example, causes the winding **54** of the stator **52** to be energized such that the rotational movement of the sprocket **36** is transmitted via the shaft piece **44** and the planetary gear set **42** to the adjusting shaft **30**. On account of the high transmission ratio in the two-stage planetary gear set **42**, the adjusting shaft **30** rotates counter to the direction of rotation of the crankshaft, but at a significantly slower speed.

The rotation takes place to the first stop **82**. When the adjusting shaft **30** or a stop mating piece which is fastened thereto buts against the first stop **82**, the coupling mechanism **40** is opened in order to avoid damage. In this case, the coupling mechanism **40** may optionally also slip.

During such a rotation of the adjusting shaft **30** in the direction of high compression, the eccentric **28** and the auxiliary piston rod **26** are placed into a virtually stretched-out position, with the first stop **82** avoiding a dead-center position in an entirely stretched-out position. As a result of the rotation of the eccentric **28** and the movement of the auxiliary piston rod **26**, the transverse lever **24** is rotated about its point of articulation **86** to the crank shaft **5**. Said rotation of the transverse lever **24**, in turn, brings about a movement of the main piston rod **22** and of the piston **16** upward. Said movement of the piston **16** is superposed on the normal oscillating piston movement and, at the top dead center of the piston movement, generates a higher piston position and therefore a higher compression in the combustion chamber in relation to a position of the adjusting shaft **30** before the latter is rotated. Said high compression is maintained for as long as the adjusting shaft **30** bears against the first stop **82**.

FIG. **2** illustrates, schematically in a cross section and a partial longitudinal section, the internal combustion engine **10** from FIG. **1** having the device **12** for varying the compression ratio, in an operating state of the adjustment to low compression. In FIG. **2**, the same elements and components are provided with the same reference numbers as in FIG. **1**.

An adjusting process to low compression of the internal combustion engine **10** takes place as follows. The coupling mechanism **40** of the drive device **38** is activated in such a manner that neither a coupling action nor a brake action is produced, i.e. for example, none of the windings **54**, **58** of the stators **52**, **56** is energized. The sprocket **36** is driven by the wraparound drive **34** and rotates loosely therewith out a connection to the shaft piece **44**. The gearing **42** therefore does not transmit any forces to the adjusting shaft **30**, and therefore the latter can rotate freely.

The integral gas pressure **20**, which is greater at high compression than at low compression, presses the piston **16** and the main connecting rod **22** downward. The trans-verse lever **24** is therefore rotated about its point of articulation **86** on the crankshaft **18**, and the auxiliary connecting rod **26** rotates the eccentric **28** and the adjusting shaft **30**. Said rotational movement can be assisted by a spring **88** which biases the adjusting shaft **30** toward the second stop **84**, since the adjusting force from the integral gas pressure **20** is small and virtually disappears close to the dead center on account of the lever ratios between the eccentric **28** and the auxiliary piston rod **26**.

The two stops **82**, **84** for the adjusting shaft **30** are arranged such that a sufficient clearance distance to a dead-center position is always maintained between the adjusting shaft **30** and the auxiliary piston rod **26**. A dead-center position between the adjusting shaft **30** and the auxiliary piston rod **26** lies here at the angles of 0° and 180° between the directions of action of the two components.

An actuation of the device **12** in order to adjust the compression ratio to a high or to a low compression can take place during continued operation of the internal combustion engine **10** at any desired operating point and is triggered by a control unit (not illustrated) as a function of various parameters, such as load, rotational speed, fuel quality, temperature and the like.

FIG. **3** illustrates, schematically in a cross section and a partial longitudinal section, the internal combustion engine **10** from FIGS. **1** and **2** having the device **12** for varying the compression ratio, in an operating state with the adjusting shaft **30** blocked. In FIG. **3**, identical elements and components are provided with the same reference numbers as in FIGS. **1** and **2**.

In this case, the coupling mechanism **40** of the drive device **38** is activated in such a manner that its brake function is activated. That is to say, the gearing **42** and therefore the adjusting shaft **30** are blocked or braked by the housing **14** by, for example, the winding **58** of the stator **56** being energized. In this way, the compression of the internal combustion engine **10** is not varied and remains at the presently set value. This brake function of the coupling mechanism **40** can be activated in principle in every rotational position of the adjusting shaft **30**, i.e. for any compression ratio.

The brake function of the coupling mechanism **40** has to be intentionally activated. In the event of a failure or malfunction of the activation or of the coupling mechanism **40**, a position of the adjusting shaft **30** with low compression is automatically assumed. In this way, it is possible for the internal combustion engine **10** to continue to operate without risk with reduced power under some circumstances, as a result of which it is possible, for example, in the case of use in a motor vehicle, to travel on to a workshop under the vehicle's own power.

With reference to FIGS. **8** to **10**, three further embodiments of a device **12** for varying the compression ratio are described in more detail below, with the drive device **38** of the invention, which device is explained in more detail above with reference to FIGS. **4** to **6**, being equally applicable to all said devices **12** without being explained in each case once again in detail.

The devices **12'**, **12"**, **12'"** for varying the compression ratio are each shown in an illustration analogous to FIG. **1**, i.e. in an operating state of the adjustment in the direction of a high compression. The same components as in the first embodiment of FIGS. **1** to **3** are again identified by the same reference numbers.

The internal combustion engine **10** of FIG. **8** has a cylinder housing **90** in which the piston **16** moves. The cylinder housing **90** is mounted so as to be pivotable about a pivot axis **92**, as a result of which the spacing of an upper edge **94** of the cylinder housing **90** from the center of the crankshaft **18** can be set to different values, and the compression ratio is thereby variable.

The device **12'** for varying the compression ratio essentially comprises an eccentric **28** and an adjusting rod **96** which serves as an adjusting link of the invention and is fastened at one side to the eccentric **28** and at the other end to the cylinder housing **90**. The eccentric **28** is arranged on the adjusting shaft **30**. As a result of the rotation of the adjusting shaft **30** and therefore of the eccentric **28** in the above-described manner, the cylinder housing **90** is pivoted by the adjusting rod **96**. The adjustment in the direction of high or low compression and the blocking of the adjusting shaft **30** in order to maintain the present compression take place by means of the drive device **38** via the device **12'** in the same manner as is described above in conjunction with FIGS. **1** to **7**.

The internal combustion engine **10** of the third embodiment illustrated in FIG. **9** has a crankshaft **18** whose center can be moved relative to the housing **14** of the internal combustion engine **10** in order to thereby vary the compression ratio of the internal combustion engine **10**.

The center of the crankshaft **18** is mounted on a base bearing eccentric **98** which, for its part, can be rotated by the device **12"** for varying the compression ratio. The device **12"** essentially comprises an eccentric **28** and an adjusting lever **100** which, on one side, is engaged by a gear **28'** at the drive device **38** and, on the other side, is fastened to the base bearing eccentric **98**. The gear **28'** is arranged on the adjusting shaft **30** which is driven, via a step-up gear wheel mechanism **102**, by the wraparound drive **34** for driving the camshafts **32** by means of the drive device **38**. By means of the rotation of the adjusting shaft **30** and therefore of the gear **28'**, the base bearing eccentric **98** is rotated by means of the adjusting lever **100**, and the compression ratio is thereby varied. The adjustment in the direction of high or low compression and the blocking of the adjusting shaft **30** in order to maintain the present compression takes place by means of the drive device **38** via the device **12"** in the same way as is described above in conjunction with FIGS. **1** to **7**.

The internal combustion engine **10** of the fourth variant embodiment illustrated in FIG. **10** has a piston **16** which is connected by means of an eccentric connecting rod bearing **104** and the main piston rod **22** to the crankshaft **18**. The eccentric connecting rod bearing **104** is fixedly connected to a connecting rod adjusting lever **106** which, for its part, can be pivoted by the device **12'"** for varying the compression ratio.

The device **12'"** here essentially comprises an eccentric **28** and a connecting rod **34** which is fastened at one side to the eccentric **28** and at the other end to the piston rod adjusting lever **106**. The eccentric **28** is arranged on the adjusting shaft **30**. By means of the rotation of the adjusting shaft **30** and therefore of the eccentric **28**, the piston rod adjusting lever **106** is moved by means of the connecting rod **108**, the eccentric piston bearing rod **104** is rotated and the compression ratio is thereby varied. The adjustment in the direction of high or low compression and the blocking of the adjusting shaft **30** in order to maintain the present compression takes place by means of the drive device **38** via the device **12'"** in the same manner as is described above in conjunction with FIGS. **1** to **7**.

The present invention is not restricted to the specific exemplary embodiments which are described above and are illustrated in the drawings. Numerous variants and modifications which lie within the scope of protection of the invention, as defined by the appended claims, are obvious to a person skilled in the art. In particular, all the features illustrated with reference to FIGS. **1** to **7** can also be used in the further embodiments of FIGS. **8** to **10**.

What is claimed is:

1. An internal combustion engine (**10**) comprising cylinders arranged in a housing (**14**), a crankshaft (**18**) rotatably supported in the housing (**14**), pistons (**16**) movably disposed in the cylinders and defining in the cylinders combustion chambers, and a device (**12**; **12'**; **12"**; **12'"**) for varying a compression ratio of the internal combustion engine (**10**), the device (**12**; **12'**, **12"**, **12'"**) including, for at least one cylinder:

an adjusting structure (**26**; **96**; **100**; **108**) for varying one of the effective length of a connecting rod (**22**) of the piston (**16**), the lift of the crankshaft (**18**) and an upper edge (**94**) of the cylinders with respect to its position relative to the center of the crankshaft (**18**);

an operating means (**28**, **28'**) mounted in the housing (**14**) for varying one of the position and the direction of the adjusting structure (**26**; **96**; **100**; **108**); and a drive device (**38**) operated by the crankshaft (**18**) and including a adjusting shaft (**30**) carrying the operating means (**28**, **28'**), and

a coupling mechanism (**40**) with an integrated brake function, by which the adjusting shaft (**30**) can either be placed in operative connection with the crankshaft (**18**) or can be locked in a particular position for maintaining a given compression ratio of the engine.

2. The internal combustion engine (**10**) as claimed in claim **1**, wherein the coupling mechanism (**40**) comprises:

a rotor (**15**) consisting of a hysteresis material which is in operative connection with the adjusting shaft (**30**);

a first pole structure (**48**) which is connected in a rotationally fixed manner to a drive wheel (**36**) driven by the crankshaft (**18**); and

a second pole structure (**60**) which is connected fixedly to the housing (**14**),

the first and the second pole structures (**48**, **60**) being activatable depending on engine operating conditions for adjusting the engine compression ratio.

3. The internal combustion engine (**10**) as claimed in claim **2**, wherein the first pole structure (**48**) is provided with a first housing-mounted winding (**54**), and the second pole structure (**60**) is provided with a second housing-mounted winding (**58**), which windings can be energized as needed for the adjustment of the engine compression ratio.

4. The internal combustion engine (**10**) as claimed in claim **1**, wherein the coupling mechanism (**40**) comprises:

an armature (**70**) made of a magnetizable material, which is in operative connection with the adjusting shaft (**30**);

a spring element (**80**) which biases the armature (**70**) into a rotational connection with a drive wheel (**36**) driven by the crankshaft (**18**); and

a selectively activatable winding (**74**) which is fixedly connected to the housing (**14**) for pulling the armature (**70**) counter to the force of the spring element (**80**) into engagement with the housing (**14**) for locking the drive device (**38**).

5. The internal combustion engine (**10**) as claimed in claim **1**, wherein the drive device (**38**) includes a gearing (**42**).

6. The internal combustion engine (**10**) as claimed in claim **1**, wherein the drive device (**38**) is operatively connected to one of a wraparound drive and a rolling contact gearing (**34**) driving camshafts (**32**) of the engine.

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